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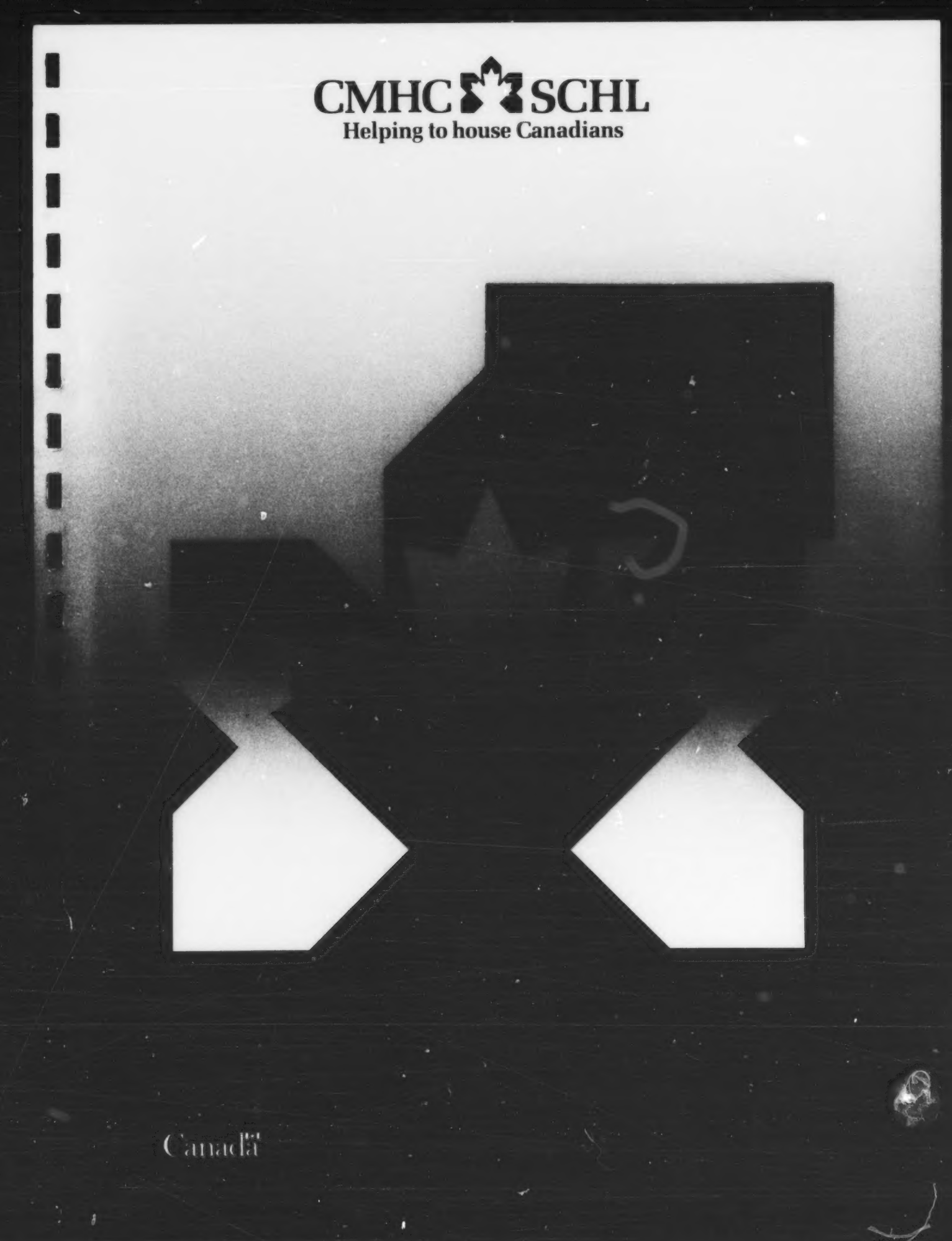

Canada

Review of Retrofit Design for an Environmentally Hypersensitive Client: Lynn Morrison Case Study

January 1991

92-01305/

Canada Mortgage and Housing Corporation, the Federal Government's housing agency is responsible for administering the National Housing Act

This legislation is designed to aid in the improvement of housing and living in Canada. As a result, the Corporation has interests in all aspects of housing and urban growth and development.

Under Part IX of this act, the Government of Canada provides funds to CMHC to conduct research into social, economic and technical aspects of housing and related fields, and to undertake the publishing and distribution of the results of this research. CMHC therefore has the statutory responsibility to make widely available, information which may be useful in the improvement of housing and living conditions.

This publication is one of many items of information published by CMHC with the assistance of federal funds.

DISCLAIMER

This document was prepared by Oliver Drerup for Canada Mortgage and Housing Corporation under Part IX of the National Housing Act. The analysis, interpretations and recommendations are those of the consultant and do not necessarily reflect the views of Canada Mortgage and Housing Corporation or those divisions of the corporation that assisted in the study and its publication.

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To:

Mr. Robin Sinha, C.M.H.C. National Office.

Report of site visit to the home of Ms. Lynn Morrison of Athens, Ontario
July 27, '90.

Present:

Ms. Lynn Morrison PHONE (613) 924-2110
Mr. Earle Winter (Ms. Morrison's Father)
Mr. Doug Ewart, (C.M.H.C. Kingston Office)
PHONE (613) 545-8040 FAX (613) 545-8036
Mr. Oliver Drerup (the consultant)
PHONE (613) 836-1494 FAX (613) 831-2730

Unable to attend:

Mr. Dave Clarence (the builder)
PHONE (613) 345-0162

Background:

Ms. Lynn Morrison has spent the last several years living on a rural property in Athens Township, Ontario. She purchased this property because she wished to be closer to her retired parents, and also because she was anxious to construct a home in a rural setting. She had identified the urban surroundings in which she worked as contributing to her failing health.

In preparation for the construction of a home, she commissioned a local contractor to build a two-car garage with an electric entrance, a well and a septic system, sufficient to meet the needs of the future homestead. The electric entrance was installed in the garage, but neither the well or the septic system were connected, awaiting the eventual house construction. Regrettably Ms. Morrison suffered a relapse during the construction. She was obligated to give up her job and leave the city sooner than she had anticipated. In light of her reduced earning power and in hopes of improving her immediate surroundings, she modified the interior of the garage to become a living space and moved in.

While far from recovered, Ms. Morrison has spent the last several years carefully monitoring her surroundings, her food stuffs and her lifestyle, and has improved sufficiently so that in 1989 she chose to pursue her initial intent to build a house on the property. She engaged a Toronto engineering firm, Allen Associates, to design and specify a building which would meet rigorous environmental criteria. Her subsequent tendering of these documents convinced her that she could not afford a new home constructed to these standards, and in view of the inconvenience of living with a privy and hauling water from the unconnected well-head, she decided to renovate the garage, to make it more comfortable. The renovation plan included a room for food storage and a bathroom. Early in this process Ms. Morrison's situation came to the attention of Doug Ewart of the C.M.H.C. Kingston Office, who in turn informed the National Office.

Construction Documents:

Eastern Engineering Group of Brockville, Ontario, have prepared two sheets of drawings; floor plans with general notes; and elevations with a section drawing. These are augmented by a nine page document entitled "Notes to Accompany Plans for Building Additions for L. Morrison" prepared by Ms. Morrison herself, in part from her own experience, and in part from the specifications previously prepared by Allen Assoc. . These documents in conjunction with input from Ms. Morrison's builder, Dave Clarence, form the planning documentation for the current undertaking. *The 2 sheets of Eastern's drawings and Ms. Morrison's "Notes" may be found in Appendix 1.*

Existing Building:

The existing building lies to the south side of a dirt road, connected by a driveway approximately 30 feet in length. The building is a slab on grade construction cast in place over foam insulation. Some perimeter foam insulation is in place at the edge of the slab. The walls are framed in 2x4, insulated with fibreglass R 12. The exterior is clad with stained, prefinished plywood. The interior is clad with galvanized roofing steel, fastened with roofing nails, over aluminum foil fastened to the studs. The same interior treatment is

employed to cover the ceiling which is insulated to R 40 with fibreglass in a conventional roof truss, sheathed with plywood, and covered with roofing steel. Windows are double glazed, awning type, and the building has two steel insulated doors. No window head-flashing is used over the openings.The North wall which was originally framed to accept two standard garage doors has had those openings framed in, insulated and covered over both inside and out. Soffit and facia treatment is in prefinished aluminum. The soffit is perforated to permit roof ventilation and the roof has a continuous ridge vent. Attic access is achieved through a gable end. The building contains no plumbing. The electric entrance has been sized for the building project as originally conceived to the meter base, but the garage contains only a 60 amp. main breaker, and circuit breaker box located on the West wall in the NW corner of the building. The heating system is composed of baseboard electric resistance convectors and the ventilation for the interior is via a through-the-wall kitchen exhaust fan. In addition, Ms. Morrison leaves windows open year round and modifies the ventilation of the building in accordance with a complex set of personal observations which include the season, prevailing wind, temperature, and sun angle.

Recommendations:

For the purpose of reviewing the options discussed at the meeting recommendations have been divided into the following categories: Design, Siting, Site Servicing, Building Materials, Building Technology, Costs.

Design:

The additions, to be made to each side of the existing garage, are for reasons of interior planning, asymmetrical. Each element, one on the East wall and one on the West wall, protrude southward of the existing garage, 4'4" and 3'0" , respectively.
As a result of this, any future development on the south gable end will require a resolution to this potentially awkward situation. In addition the valley flashing required to make good the roof connecting the various elements will be unusual. The Morrisons were well aware of this potential problem and had discussed it with their builder, in whose hands the situation was left.

Siting

In many ways the current location of the building is ideal. Although unfortunately close to a road, traffic volume is low and the roadway largely unimproved, which reduces the exposure to asphalt, median strip painting, repairs and automobile exhaust. The building lies below the crest of the road thus the driveway is graded toward the north wall originally intended to serve as the location of the garage doors. (SEE PHOTO # 1) The gravel drive has been permitted to cover the bottom of the plywood exterior sheathing along this wall and represents a potential means of entry for capillary water and insects. (SEE PHOTO # 2) The free draining nature of the gravel drive, as well as the lay of the land suggests that bulk moisture will drain away. The soil contact between the building and the ground should be broken by creating a swale between the parking spaces and the building and lowering the level of the ground along the North wall. This would have the additional benefit of channeling water away from the gravel under the concrete slab and could potentially improve control over interior humidity levels as no means exists to verify the quality of the damp-proof-course under the concrete slab. To the South of the building, and close in to its walls is a thicket of vegetable matter consisting in part of an old chicken run and sumac bushes. This area should be cleared to improve air drainage of the site. (SEE PHOTO # 3) Ms. Morrison has intended to undertake this task for some time and will no longer require the privy located on this side of the building once a bathroom has been installed.

Site Servicing

The most difficult and potentially expensive shortcoming of the location is a periodic impotability of the water. At present, a drilled well located approximately 40 feet West of the building and unconnected to the structure prior to the construction of the additions, is capable of supplying an adequate volume year round. Unfortunately, Ms. Morrison reports a seasonal mold growth in the ground water. This problem can be controled using bleach but the treatment renders the water equally unusable for substantial periods. Several solutions occurred to the Morrisons prior to our meeting. Ms. Morrison had observed that bleach-treated water

allowed to stand or actively aerated prior to use, was improved, and had considered designing an aeration system consisting of an open tank, interior to the building to avoid freezing, into which pressurized water pumped from the well would be sprayed. (SEE MS. MORRISONS NOTES TO ACCOMPANY PLANS ITEM 6 +7) We recommend that this plan be abandoned, not only because of the necessity to design or source an unusual device but because aerating the products of either bleach treatment, or the mold itself, into the living space is undesirable. A further concern for the plasticizers used in conventional polypropolyne water piping had caused Ms. Morrison to consider stainless steel in-ground piping. The current thinking is that a new well will have to be developed at some time in the future to obtain tolerable drinking water. Our recommendation, in light of this future requirement, is to use galvanized iron or copper pipe to avoid the expense of a stainless connection and to haul water from a neighbors, as is done now, for drinking water only, until a new well can be constructed. The cost savings, based on preliminary figures obtained by Mr. Morrison, would be substantial.

Building Materials:

Virtually all decisions in this area must be guided and informed by Ms. Morrison's preferences. Nonetheless certain issues are obvious and demand comment. The condition of the existing vapour diffusion retarder/ air barrier in the wall and ceiling is unknown. It is our understanding, without dismounting the galvanized steel roofing panels that form the interior finish, that this barrier is constructed of aluminum foil, applied in rolls some 30" wide. Continunity in this circumstance is unknown. The interior roofing steel has corrugations rolled into its surface which communicate to the living space. As a result, the interior finish cannot be considered impermeable despite the material itself being made of metal sheet. We are concerned that the exterior plywood and fibreglass insulation, with their potential formaldehyde burden, in addition to any moisture induced degradation, could communicate into the living space. Our current proposal calls for the removal of the exterior siding and the installation of Baseclad, Tyvek, and aluminum siding. This will have the effect of warming the wall cavity and creating a drainage layer on the exterior of the wall while avoiding interior disruption. The steel sheeting used for the interior finish is nailed to the walls and

ceiling using conventional roofing nails that employ neoprene washers to obtain water-tight seals. It seems preferable that these washers be removed. In the additions flat stock and conventional flat head roofing nails should be considered. In regard to other materials interior to the building, some of our past clients, have demanded that the electric entrance be shielded from the living space and that concrete free of water reducing agents be used. Ms. Morrison is well informed on these matters and has dealt with a wide variety of these concerns in her document appended to this report.

System Advantages:

The use of a slab-on-grade foundation system.
Removal of exterior cladding in favor of insulative sheathing.
Simplicity of detail and selection of interior finish.
Utilization of existing well and septic system.
Close client supervision.

Project Assessment;

This circumstance, complicated by a very limited budget, has necessitated making do with a series of less than ideal givens. Ms. Morrison deserves respectful congratulations for her flexibility and her thorough research in trying to better understand how to take control of her life. We must recognize that this effort is called for at a time when, due to her illness, the ability to concentrate and prepare well reasoned arguments is at low ebb. Given these constraints and the added difficulty of finding sympathetic help, the project could hardly be proceeding in a more trouble-free manner. This said, the construction documents contain several contradictions (i.e. fibreglas sill gasket vs. closed cell silicone foam sheet) which we can only assume will be resolved between Ms. Morrison and her builder, Dave Clarence. Ms. Morrison is so well aware of the importance of materials choice and Mr. Clarence so anxious to assist in construction of the building, that many of these problems will no doubt be resolved satisfactorily during construction.

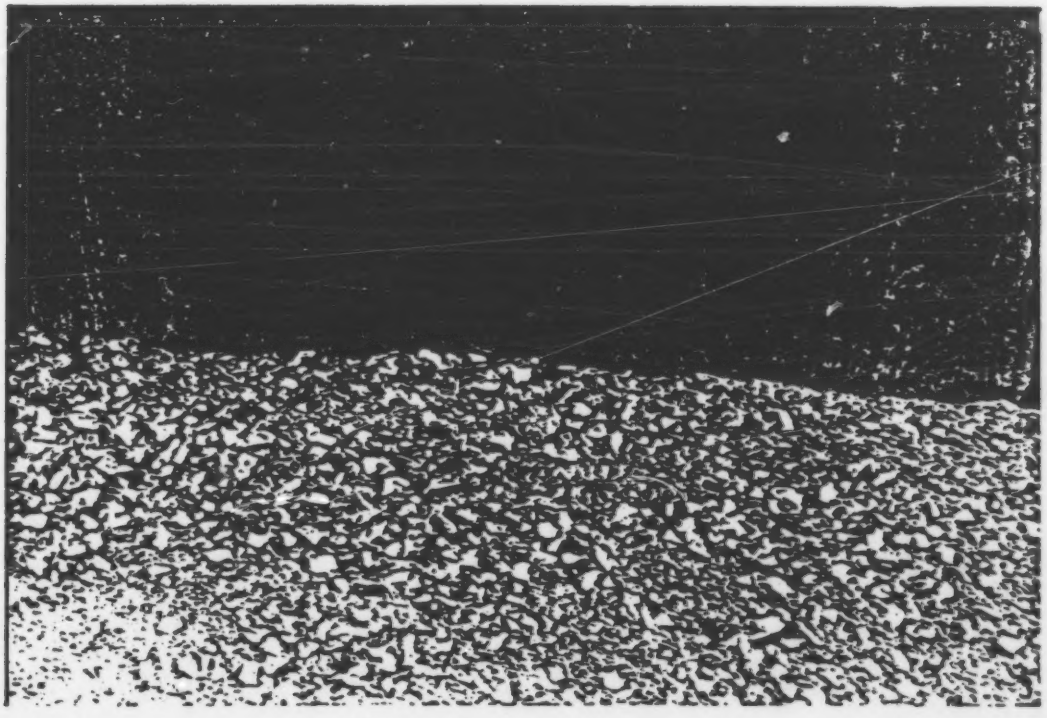
Costs:

Although we did not undertake a complete review of Mr. Clarence's cost estimates we were given to understand that costs of

thirty-five to forty thousand dollars were expected for the project. In our opinion these are not only realistic but reasonable expenditures in light of the project requirements. If the aeration tank and stainless steel well line are abandoned some savings may be expected in the plumbing, however it is important to recognize that the job is a renovation and unexpected problems are sure to arise. With this in mind forty thousand dollars seems an entirely acceptable capital cost.

Appendix A

Photographs



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Appendix B

Notes to Accompany Plans for

Building Additions for L. Morrison

Notes to Accompany Plans for
Building Additions for L. Morrison

N.B.: Am open to discussion to any parts of these notes prior to finalizing estimates, except for necessity for me to be aware of all materials and building methods we will be using, and to have tolerance testing where I feel it's necessary.

L. Morrison

Concerns:

1. No heavy machinery within maple tree drip line - no digging of ditches for water lines within drip line.

2. React to wood fumes, fiberglass and coating on gypsumboard. Therefore - aluminium foil vapour barrier must be installed asap once bathroom/entry addition has the walls enclosed.

   (Post Construction Note: Used a tightfighting lockable door (former outer steel insulated door) and found that keeping this closed and locked and using other door, solved temporary problems w/ fumes).

   Put stove on new outside wall section to avoid ductwork which would be difficult to clean - must vent above door and window height.

   (Post Construction Note: Having major problems w/ trying to raise the level of fumes exhausted to above window height without decreasing effectiveness of exhaust too much - new location is right beside one of my south air intake windows).

   All metal ducting required for exhaust fans to be washed and rinsed, inside and out - all ducting to exhaust above door, window openings - check locations w/owner before installing.

   Needed to specify aluminium rather than fiberglass screening for exhaust openings to keep out bugs.

3. No smoking close to open windows. Avoid smoking upwind from the building to prevent smoke coming in the windows.

   No smoking inside enclosed or roofed additions.

5. Where (and if) some caulking materials must be used, must have opportunity to test.

6. Must have opportunity to test materials for tolerance prior to installation (where tolerance levels are unknown).

7. Need warning if must run gas/oil fuelled engines, to close windows ahead of time.

8. No cleaning solvents, etc, without clearing with me first (mechanical cleaning only).

9. Need slabs broom cleaned at end of each working day and will shut windows prior to this, as soon as requested.

Material notes for sealing:

- Caulking, Gasketing, Taping:
  - Where confering w/owner ends in agreement that caulking must be used, rec. silicone 2 from G.E. and seal from inside of building with aluminium foil tape (i.e. keep caulking fumes from entering house).
  - Aluminium foil vapour barrier to be taped w/aluminium foil-faced tape (after barrier has been stapled at seams) - tape must cover staples and seams.
  - Tyvek only to be taped w/Contractor's sheathing tape from 3M #5J-8086.

    (Post Construction Note: didn't use tape - folded edges over outer fiberglas sheathing to hold in place until siding applied).
  - Where confering w/owner ends in agreement that gasketing must be used under sills, use Closed Cell Silicone Foam Sheet-from Armet Industries Corporation, Concord Ontario and seal with foil tape from inside of building.

    used under sills,

Construction Notes for Sealing:

1. Where Interior Partition meets insulated wall, aluminium foil vapour barrier to run continuous behind partition.

   Install Interior partitions after insulated walls are completely finished.

2. Where mechanical ducts, plumbing, etc. must penetrate the vapour barrier, installer to carefully caulk and then tape vapour barrier to penetration using aluminium foil-faced tape, sealing caulking behind vapour barrier.

   (Post Construction Note: stuffed gaps w/ fiberglass and taped over joints, w/ aluminium foil tape on interior).

3. Where electrical wires must penetrate vapour barrier, in exterior wall, installer to carefully cut gasket material to fit behind cover plate. Where cover plate cannot be used, installer will carefully caulk and then tape vapour barrier to wire using aluminium foil-faced tape and sealing caulking behind barrier.

(Post Construction Note: Laid aluminium foil vapour behind electrical boxes and brought out edges over interior wall aluminium foil vapour barrier, then taped 2 together. Used aluminium foil tape to tape opening where wires came thru vapour barrier).

Carpentry Notes:

1. Structural lumber shall be spruce grade #1.

2. Building frame to be fully braced using let in 1" x 4".

3. Joists and rafters to have minimum 1½" bearing use metal joist hangers where required.

4. Interior framed partitions to be framed w/washed steel studs. (It is necessary to skin interior wall of services closet).

   (Post Construction Note: Steel studs and steel door didn't need washing, unlike the galvalume sheeting used for the walls and angle pieces of trim).

Wall, Ceiling, Floor Joints

Purpose: To seal wood, fiberglass fumes from exterior walls.

1. Seal Joints where exterior walls meet concrete floor.

   (Post Construction Note: Laid washed galvalume strips bent to 90° angle under edge of wall, into a thin layer of wet concrete, then screwed wall down to tops of angle pieces, and bottom of angle pieces to floor).

2. Seal Joints where exterior walls meet ceiling in interior

   (Post Construction Note: Used galvalume strips bent into 90° angles to cover over places where exterior walls met (on the inside only) or where the ceiling met the walls).

Interior Walls:

1. Wash steel/galvalume sheeting over unwashed steel studs by hand, rinse and then dry by hand and check to make sure the oil smell is gone.

   (Post Construction Note: oil was very persistant).

2. On both for closet.

   - For interior of services closet - only one side.

Wiring:

1. If not sealed behind aluminium foil vapour barrier and taped w/aluminium foil tape, require wiring to be enclosed in metal piping - for all wiring in interior walls.

   (Post Construction Note: Taped 2 wires by covering w/ foil and aluminium foil tape, rest covered w/ washed metal pipes for wiring on interior walls).

2. Check light fixtures w/ owner for tolerance.

   (Post Construction Note: Used ceramic bases and glass globes).

3. Prefer chrome or porcelain or non-coated metal bases (requiring no future finish), glass covers

Plumbing: To Be Discussed with Plumber

Location Intake and Drain Lines (Avoid Tree dripline)

- Floor Drain in services closet

- Avoid disturbing current pump and well pipe (gasket removed to allow drain-back to avoid freezing).

- Raise a few feet to install water feed line and then lower back down.

  (Post Construction Note: Plastic pipe fumes are better than they were 3 years ago due to calcification. Will try to rig some way of airing tank for shower water at the top of the shower if this proves necessary).

- Must use copper intake line run thru concrete floor but run inside plastic casing pipe-cut it back at the top of the floor and fill in w/ concrete to seal top.

- Capability of installing water filtration unit on stainless steel septic tank line going to kitchen sink cold water tap.

- (Post Construction Note: Using real-glass lined pressure tank w/ plastic float - a sheet of plastic w/ a rubber ring fastened to its outside edges - pretty nasty, but it seemed like our best option of current choices available for pressure controls for the deep well pump).

- All hot and cold water lines insulated w/foil-faced rigid fiberglass pipe insulation.

Plumbing: To Be Discussed with Plumber

- Pipe runs in services closet walls do not need to be enclosed between 2 steel walls
- Hot electric water heater must be real-glass-lined due to algae growth problems and volume of hot water actually used.
- Run plastic drain pipe thru concrete floor where necessary to run line thru floor - connections to above floor - use copper piping:
- Backflow preventer necessary.
- Provide shut-off valves for all hot and cold water lines at all faucets.
- No pipe runs to be installed within sealed walls.
- Towel bars, etc. as agreed upon w/owner.
- (Post Construction Note: Investigating ways of removing:

  a) chlorine from well, (having to periodically chlorinate well because of recurring algae growth in well

  b) Copper from new copper feed lines.

  c) Plastic from new rubber float.

- (Post Construction Note: Currently looking at stainess steel distiller if the filter material can be changed to one I tolerate).
- (Post Construction Note: An enamelled-steel laundry tub and the smaller real glass lined hot water tank 50/ can't comment beyond this point).